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this dark border (which sends all round many ramifications in every direction) is nothing but the result of the melting of the snows of the northern polar cap. On this supposition the various phenomena which it presents can be very well explained, while the hypothesis of Professor SCHAEBERLE would lead to various difficulties.

Such are, for the moment, my ideas on this point. I recognize that they are, as yet, hypothetical in great part, and I am quite ready to modify them and to adopt other ones, if the latter are more accordant with observations. * * * * *

G. V. SCHIAPARELLI.

A note from Professor SCHIAPARELLI, dated June 7, acknowledges the receipt of some photographic copies of drawings of *Mars* made at the LICK Observatory in 1893. On these Professor SCHIAPARELLI remarks that he has recognized the doubling of the canals designated on his chart by the names *Ganges*, *Euphrates* and *Hydaspes*. The two first have been observed to be double on many occasions, but the doubling of *Hydaspes* is noticed for the first time. E. S. H.

REMARKS ON THE SURFACE-MARKINGS OF *MARS* [BY J. M. SCHAEBERLE].

To the objections which Professor SCHIAPARELLI raises against my interpretations of the surface-markings on the planet *Mars*, I have the following to say: My views are based upon two striking and well observed facts which I interpret as follows:

First—The *observed* gradual obliteration of surface details with increasing distance from the center of the disk of *Mars* towards the circumference indicates the presence of a spherical shell of matter (atmospheric) above the general surface of the planet, which absorbs and obstructs some solar light which would otherwise be reflected from the surface.

Second—The *observed* corresponding increase in the brightness of the disk of *Mars* with increasing distance from the center to the circumference indicates that the reflecting particles of matter in this spherical shell (atmosphere) are of such a density and reflective power that more light is actually reflected from this shell than from the general surface of the planet.

If these interpretations are in accordance with the actual conditions of things *above* the surface of *Mars*, it would seem that certain arbitrarily assigned surface conditions would result in certain definite phenomena which could be predicted. Conversely, if certain phenomena are *observed*, the surface conditions can no longer be arbitrarily assigned.

Referring now to Professor SCHIAPARELLI'S first objection, I wish to say that as the Alpine lakes are situated at altitudes which practically place them far above those terrestrial atmospheric strata, which cause a bright sky, his illustration is hardly a fair one.

Granting that water absorbs $\frac{49}{50}$ of the normally incident light, I still cannot agree with him that the cause of the blackness of these lakes is mostly due to the great absorptive power of the water, indeed I even venture to say that if all the same incident light were *totally* reflected from the water's surface, these same lakes would, by contrast with other terrestrial reflections at the water's surface, appear quite as black.

In order to satisfy myself more fully on certain points, a few simple experiments were made, some of which are described below so that they can be easily repeated by anyone desiring to do so.

A vessel lined with black velvet cloth to prevent internal reflections, was filled with water and placed alongside of a basin of mercury vertically under the zenith shutters in the meridian circle room. The shutters are painted a light grey color on the inside.

When these shutters were opened so as to admit only a narrow line of sky light directly overhead, the reflection from each surface appeared as a line of *white* light, that one from the mercury surface being of course the brighter. When, however, the shutters were wide open and illuminated by direct sunlight, the sky by contrast was of a deep blue color in both reflecting surfaces, that from the water surface being of a deeper hue than the sky reflection from the mercury surface. In both reflections the sky appeared much darker than the shutters, the contrast being very much the greatest for the mercury surface.

An idea of the peculiar character of the zenith sky reflection can be gathered from the next experiment. The same water vessel was placed upon some ordinary pieces of grey rock, of which Mt. Hamilton is so largely composed, and which is very much brighter in sunshine than the vast fields of chapparal-covered ground, which by contrast with the sky actually appear black to the eye. A short tube was then so placed that equal areas of sun-illumined rock and of water surface could be seen. An unbiased, intelligent individual being asked to look down the nearly vertical tube, actually maintained that the sky reflection from the water surface was brighter than the sun-illumined ground. Other unbiased observers invariably complained that the character of the two lights was wholly different, but agreed that the reflection from the ground seemed to be the most effective.

In the next experiment, the water surface, the rocks, and the writer (on an overhanging roof thirty feet above) were exposed to full sunshine. The sunlight reflected from my face and mirrored in the water surface below, was brighter than the reflection from the sun-illumined rock on which the vessel rested. So plain was the image, although at an equivalent distance of 60 feet, that the features were unmistakably recognized. The parts of my body in the shade appeared dark in projection against the reflected image of the deep blue zenith sky of Mt. Hamilton.

The reflected image of a white sheet of tissue paper held in the sunlight to represent a milky sky, was very much brighter than any terrestrial object beneath me, both by light transmitted through the paper and by reflection from the side exposed to the Sun.

From these and other experiments I infer that a milky sky will, when viewed from a point wholly exterior to the Earth, always cause a water surface to look brighter than a land surface. If the horizon of Mt. Hamilton were of the same deep blue color as its zenith, San Francisco Bay would appear black compared with the surrounding country even though the angles of incidence and reflection are such that but little light is absorbed by the water.

I would meet Professor SCHIAPARELLI'S second objection with the reply that during the last opposition I observed precisely the same phenomenon in the south polar regions which he describes as occuring near the north pole, as can be seen from those of my drawings already published, *and yet we both agree in making the south polar regions dark*. The phenomena accompanying the gradual diminution in the size of the white south polar cap were closely watched, and while I can give no consecutive series of observations illustrating the changes which the north polar cap undergoes, all my drawings of the south polar region represent that part of the disk of *Mars* as dark and always most intensely so just along the edge of the white zone. I have all along been inclined to attribute this marked variation in shade almost wholly to the sharp contrast between the excessive whiteness of the cap and the much less brilliant surface of the planet.

If this dark shading is simply a matter of contrast, no additional conditions are required to account for the observed phenomena of the north polar region regarded as a water area; the gradual melting of an ice cap covered with snow would offer a satisfactory explanation. At the south pole it would be a land area covered with snow.

An interpretation of my own observations and drawings, whatever their real value may be, leads to conclusions which are not compatible with the hypothesis that the darker irregularly-shaded markings correspond to water areas, and the uniformly bright portions to land areas. Such would in part be the case if *Mars* possessed no light-dispersing atmosphere; but the observed increase in brightness from the center of the disk to the circumference with an accompanying loss of surface detail, alone almost completely demonstrates the presence of an atmosphere highly charged with matter capable of reflecting the Sun's light. Such an envelope about *Mars* would of course tend to diminish the brightness of the land surfaces, and to very much increase the brilliancy of the water surface.

It seems to me that if the presence of such an atmosphere is taken for granted, the land and water-markings heretofore assigned must be interchanged. J. M. SCHAEBERLE.

LICK OBSERVATORY, August 20, 1893.

EXPERIMENTS IN PHOTOGRAPHING THE CORONA.

We learn from a short note in *Astronomy and Astro-Physics* for August that Professor HALE, of Chicago University, recently attempted, from a station on Pike's Peak, to photograph the solar corona *without an eclipse.* This is a problem which HUGGINS, HALE and DESLANDRES have attacked in various ways, with considerable expectation of success. Professor HALE does not regard the observations with his "coronograph" as at all successful, possibly owing to the fact that the atmospheric conditions on Pike's Peak were surprisingly poor. We trust the various methods suggested will soon be put to the final test under perfect conditions. W. W. C.